Parametric analysis

This example shows the effect of varying input resistance on the bandwidth and gain of the clipper circuit by:

- Changing the value of R1 to the expression {Rval}.
- Placing a PARAM part to declare the parameter Rval.
- Setting up and running a parametric analysis to step the value of R1 using Rval.

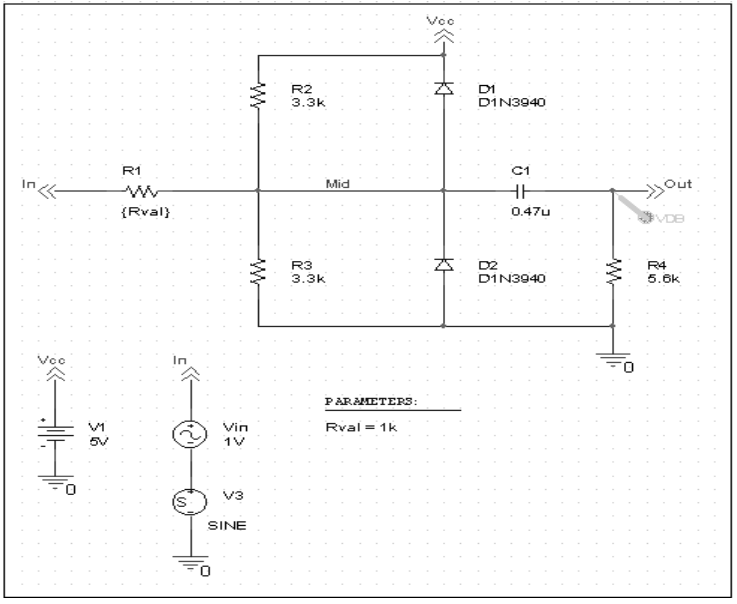

Figure 22 *Clipper circuit with global parameter Rval.*

This example produces multiple analysis runs, each with a different value of R1. After the analysis is complete, you can analyze curve families for the analysis runs using PSpice A/D.

Setting up and running the parametric analysis

To change the value of R1 to the expression {Rval}

1. In Capture, open CLIPPER.OPJ.
2. Double-click the value (1k) of part R1 to display the Display Properties dialog box.
3. In the Value text box, replace 1k with `{Rval}`.
4. Click OK.

PSpice interprets text in curly braces as an expression that evaluates to a numerical value. This example uses the simplest form of an expression — a constant. The value of R1 will take on the value of the Rval parameter, whatever it may be.

To add a PARAM part to declare the parameter Rval

1. From Capture's Place menu, choose Part.
2. In the Part text box, type `PARAM` (from the PSpice library SPECIAL.OLB) , then click OK.
3. Place one PARAM part in any open area on the schematic page.
4. Double-click the PARAM part to display the Parts spreadsheet, then click New.
5. In the Property Name text box, enter `Rval` (no curly braces), then click OK.

   This creates a new property for the PARAM part, as shown by the new column labeled Rval in the spreadsheet.
6. Click in the cell below the Rval column and enter `1k` as the initial value of the parametric sweep.
7. While this cell is still selected, click Display.
8. In the Display Format frame, select Name and Value, then click OK.
9. Click Apply to update all the changes to the PARAM part.
10. Close the Parts spreadsheet.
11. Select the VP marker and press Delete to remove the marker from the schematic page.
12. From the File menu, choose Save to save the design.

Note *For more information about using the Parts spreadsheet, see the Orcad Capture User's Guide.*

This example is only interested in the magnitude of the response.

To set up and run a parametric analysis to step the value of R1 using Rval

1 From Capture's PSpice menu, choose New Simulation Profile.

The New Simulation dialog box appears.

2 In the Name text box, type `Parametric`.

The root schematic listed is the schematic page associated with the simulation profile you are creating.

3 From the Inherit From list, select AC Sweep, then click Create.

The Simulation Settings dialog box appears.

4 Click the Analysis tab.

5 Under Options, select Parametric Sweep and enter the settings as shown below.

This profile specifies that the parameter Rval is to be stepped from 100 to 10k logarithmically with a resolution of 10 points per decade.

The analysis is run for each value of Rval. Because the value of R1 is defined as {Rval}, the analysis is run for each value of R1 as it logarithmically increases from 100Ω to 10 kΩ in 20 steps, resulting in a total of 21 runs.

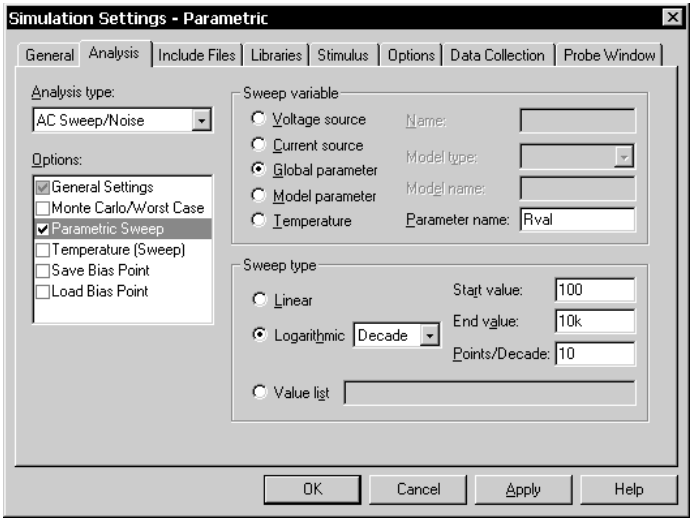

Figure 23 *Parametric simulation settings.*

6 Click OK.

7 From the PSpice menu, choose Run to start the analysis.

Analyzing waveform families

Continuing from the example above, there are 21 analysis runs, each with a different value of R1. After PSpice completes the simulation, the Available Sections dialog box appears, listing all 21 runs and the Rval parameter value for each. You can select one or more runs to display.

To display all 21 traces

1 In the Available Sections dialog box, click OK.

All 21 traces (the entire family of curves) for VDB(Out) appear in the Probe window as shown in Figure 24.

To select individual runs, click each one separately.

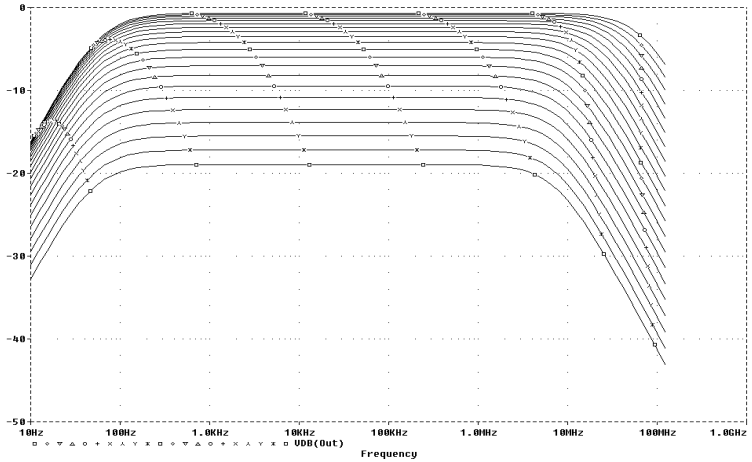

Figure 24 *Small signal response as R1 is varied from 100Ω to 10 kΩ*

To see more information about the section that produced a specific trace, double-click the corresponding symbol in the legend below the x-axis.

2 Click the trace name to select it, then press Delete to remove the traces shown.

You can also remove the traces by removing the VDB marker from your schematic page in Capture.

To compare the last run to the first run

press Insert or

1 From the Trace menu, choose Add Trace to display the Add Traces dialog box.

2 In the Trace Expression text box, type the following:

```
Vdb(Out)@1 Vdb(Out)@21
```

You can avoid some of the typing for the Trace Expression text box by selecting V(OUT) twice in the trace list and inserting text where appropriate in the resulting Trace Expression.

3 Click OK.

Note *The difference in gain is apparent. You can also plot the difference of the waveforms for runs 21 and 1, then use the search commands to find certain characteristics of the difference.*

4 Plot the new trace by specifying a waveform expression:

press Insert or

a From the Trace menu, choose Add Trace.

b In the Trace Expression text box, type the following waveform expression:

```
Vdb(Out)@1-Vdb(OUT)@21
```

c Click OK.

5 Use the search commands to find the value of the difference trace at its maximum and at a specific frequency:

a From the Trace menu, point to Cursor and choose Display.

b Right-click then left-click the trace part (triangle) for Vdb(Out)@1 - Vdb(Out)@21. Make sure that you left-click last to make cursor 1 the active cursor.

c From the Trace menu, point to Cursor and choose Max.

d From the Trace menu, point to Cursor and choose Search Commands.

e In the Search Command text box, type the following:

```
search forward x value (100)
```

The search command tells PSpice to search for the point on the trace where the x-axis value is 100.

f Select 2 as the Cursor to Move option.

g Click OK.

Figure 25 shows the Probe window with cursors placed.

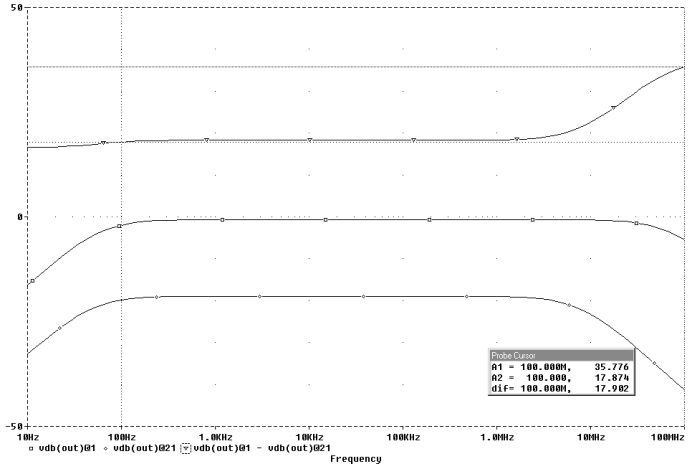

Figure 25 *Small signal frequency response at 100 and 10 kΩ input resistance.*

Note that the Y value for cursor 2 in the cursor box is about 17.87. This indicates that when R1 is set to 10 kΩ, the small signal attenuation of the circuit at 100Hz is 17.87dB greater than when R1 is 100Ω.

6 From the Trace menu, point to Cursor and choose Display to turn off the display of the cursors.

7 Delete the trace.

Finding out more about parametric analysis

To find out more about this...	See this...
parametric analysis	Parametric analysis on page 12-382
using global parameters	Using global parameters and expressions for values on page 3-107